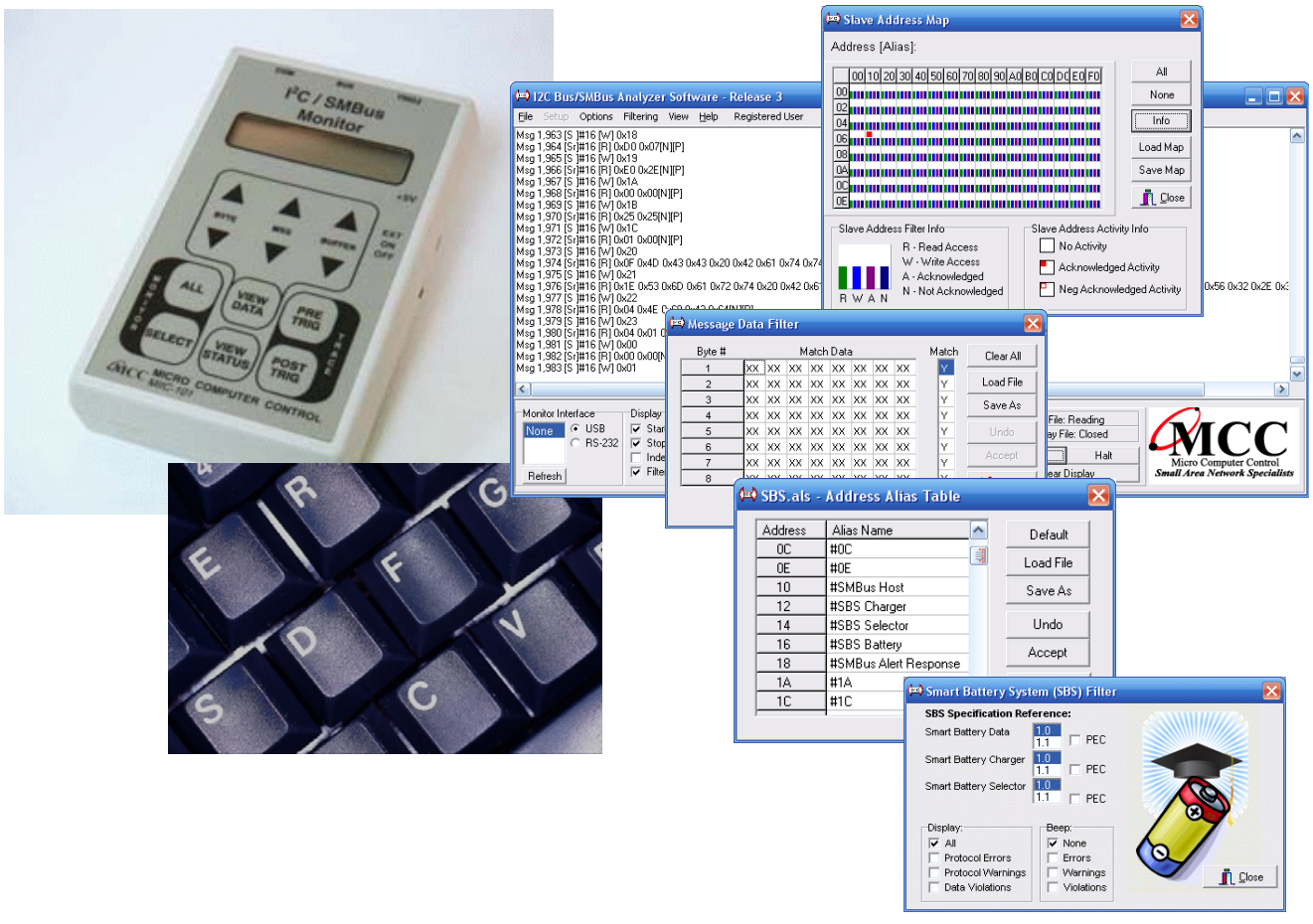
I²C Bus/SMBus Monitor with USB or RS-232 Interface, I²C Bus/SMBus Analyzer Software, and Programmer's Reference

Release 3



Micro Computer Control Corporation

www.mcc-us.com

Introduction

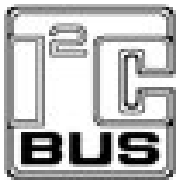
The MCC I²C Bus/SMBus Monitor (#MIIC-101) is a Troubleshooting Tool for the I²C Bus (Inter-Integrated Circuit Bus) developed by Philips/NXP, and a wide variety of bus implementations and protocols based upon the I²C Bus.

What's New in Analyzer Software!

- USB or RS-232 Host Computer Interface
- Slave Address Read/Write/Ack/Nack Display Filter
- Message Data Match/No-Match Display Filter
- Smart battery with PEC Support
- Smart battery Error/Warning/Data-Violation Display Filter
- Message Start Timestamp with Absolute/Relative/Date+Time Display
- Message Display Recording to File.
- Message Data Byte Index Display
- Hex/Decimal/Binary/ASCII/Comma-Delimited Data Display

This user's guide describes the installation and operation of the I²C Bus/SMBus Monitor and the optional I²C/SMBus Analyzer Software Package for Windows, and includes a Programmer's Reference section to aid in creating custom bus monitoring applications.

Are you new to I²C or SMBus? Want to know more? We suggest you click the link "What is I²C?" on our web site home page (www.mcc-us.com).



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WARNING - Life Support Applications: MCC products are not designed for use in life support appliances, devices, or systems where the malfunction of the product can reasonably be expected to result in a personal injury.

WARNING - Radio Frequency Emissions: This equipment can radiate levels of radio frequency energy that may cause interference to communications equipment. Operation of this equipment may cause interference with radio, television, or other communications equipment. The user is responsible for correcting such interference at the expense of the user.

WARNING - Electrostatic Discharge (ESD) Precautions: Any damage caused by Electrostatic Discharge (ESD) through inadequate earth grounding is NOT covered under the warranty of this product. See the “Electrostatic (ESD) Precautions” section of this guide for more information.

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Part 1

I²C Bus/SMBus Monitor

Installation and Overview

Model No. MIIC-101

1 Overview

The MCC I^2C Bus/SMBus Monitor (#MIIC-101) is a Troubleshooting Tool for the I^2C Bus (Inter-Integrated Circuit Bus) developed by Philips/NXP, and a wide variety of bus implementations and protocols based upon the I^2C Bus. When connected to an active bus, the I^2C Bus/SMBus Monitor can capture, filter, and display bus message activity.

The I^2C Bus/SMBus Monitor can operate in two modes, stand-alone and remote. In *stand-alone mode*, the built-in display and keypad support the capture and display of bus messages. In *remote mode*, the monitor is controlled by a host computer via a USB or RS-232 communications port.

To assist remote mode operation, MCC offers optional Windows-based I^2C Bus/SMBus Analyzer software (#SMB-SW) that can control the monitor unit from a host computer. This software allows bus message data to be captured, logged, filtered, displayed, and analyzed using various display options and one of several built-in bus protocol parsers, including the display of Smart Battery System (SBS) messages in engineering units.

In addition to MCC's standard software, a customer may also develop custom software to meet special processing requirements. Custom software can control, collect, and upload live or pre-recorded bus message data to a host system. This provides a powerful tool for integrating the monitor into an automatic manufacturing-test environment. Remote control is accomplished via a series of ASCII text commands. A description of the monitor's command set is provided in the Programmer's Reference section of this manual.

1.1 Product Features

- I^2C Bus and SMBus Compatible.
- Stand-Alone and Remote Operating Modes.
- Captures bus traffic to 100kHz with minimal clock-stretching.
- Compatible with 3.3 to 5 volt bus logic.
- Stores up to 2700 bus messages in stand-alone mode. Unlimited in remote-mode.
- USB or RS-232 host computer communications interface.
- Optional analysis software integrates monitor and PC resources.

1.2 Packing Slip

The I²C Bus/SMBus Monitor package includes the following items:

- I²C Bus/SMBus Monitor unit.
- I²C clip-lead cable (#CABCL).
- I²C interface cable (#CAB4).
- External trigger clip-lead cable.
- USB or RS-232 interface cable.
- Power supply.
- User's guide.
- Optional Windows-based Analyzer Software.

1.3 System Requirements

The I²C Bus/SMBus Monitor can be used in stand-alone mode or host computer controlled remote mode.

1.3.1 Stand-Alone Mode

To use the I²C Bus/SMBus Monitor in stand-alone mode, the system under test must meet the following requirements:

- I²C Bus or SMBus compliant.
- Operate the bus at 100kHz or less.
- Support bus clock-stretching.
- Operate with a 3.3 volt to 5 volt pull-up voltage.

1.3.2 Remote Mode

To use the I²C Bus/SMBus Monitor in remote mode with the I²C Bus/SMBus Analyzer Software, the system under test must meet Stand-Alone Mode requirements, and the host computer must meet the following requirements:

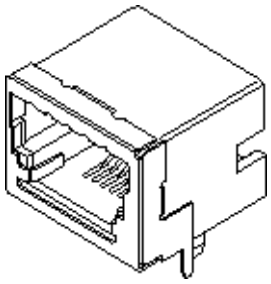
- MCC I²C/SMBus Monitor (#MIIC-101) for data capture.
- Microsoft Windows XP (x86), Vista (x86/x64), 7 (x86/x64).
- 1 Free USB or RS-232 Port.

2 Interconnects

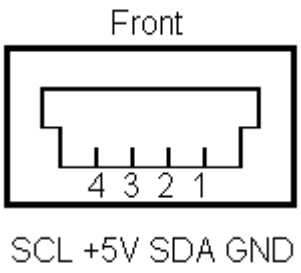
The I²C Bus/SMBus Monitor includes three interconnections, BUS, COM, and TRIG↓.

2.1 I²C Bus/SMBus Connector (BUS)

The I²C Bus/SMBus Monitor includes a four-wire, positive locking, modular receptacle connector (BUS) for interfacing to the I²C Bus or SMBus of a target system. Lines provided include Clock (SCL), Data (SDA), Ground, and +5VDC.



Receptacle Connector



The minimum test connections are Clock, Data, and Ground. Use of the +5V wire is optional. Connect the +5V wire to the target system to power the I²C Bus/SMBus Monitor and the target system from a common regulated 5V power supply. See the "External Power" section of this guide for additional information.

The I²C Bus/SMBus Monitor includes two cables that can be used to connect the monitor unit to a target system, a clip-lead cable, and an I²C Bus interface cable. Both cables use a common modular plug for connection to the monitor unit, and a common wire color coding (White = Clock, Red = +5VDC, Green = Data, Black = Ground).

2.1.1 Clip-Lead Cable

The clip-lead cable (#CABCL) provides an easy clip-on connection to the system under test. Test clips are provided for:

Clip ID	Signal	Description
G	GND	Ground Line
D	SDA	I²C/SMBus Data Line
V	V	+5V (Optional)

C	SCL	I^2C/SMBus Clock Line

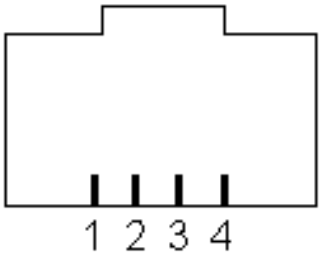
2.1.2 Alternate Interface Cable

The I^2C interface cable (#CAB4) provides an alternate method to connect the monitor unit to a target system. This interface cable provides an MCC I^2C modular plug at both ends. Since there is no standard I^2C Bus or SMBus connector, you may want to cut off one end of the interface cable and add a connector compatible with your target system.

Additional clip-lead cables, I^2C interface cables, and mating modular receptacle connectors are available from MCC. (see Appendix A)

2.2 USB/RS-232 Host Computer Interface (COM)

The I^2C Bus/SMBus Monitor is available with USB or RS-232 host computer interface cables. Both interface cable types plug into the monitor's RJ-45 type serial port connector (COM), and provide connection to an optional host computer system for remote control and data uploading capabilities.



COM Port
Connector

Pin	Signal	Description
1	CTS	Clear To Send (Host > Monitor) (Optional)
2	TX	Data (Monitor > Host)
3	GND	Ground Line
4	RX	Data (Host > Monitor)

The USB interface cable requires the installation of a USB Virtual Communications Port (VCP) driver. This driver is automatically downloaded and installed from the Microsoft Windows Updater website when the cable is plugged into a USB port on the host computer. See Appendix C for additional RS-232 interface information.

2.3 External Trigger (TRIG↓)

An External Trigger port connector (TRIG↓) and clip lead provides Trace synchronization with external signals. The trigger is activated on a high to low signal transition.

3 Monitor Unit Set-Up

3.1 ESD (Electrostatic Discharge) Precautions

Electrostatic discharge is defined as the transfer of charge between bodies at different electrical potentials. Electrostatic discharge can change the electrical characteristics of a semiconductor device, degrading or destroying it. Electrostatic discharge also may upset the normal operation of an electronic system, causing equipment malfunction or failure.

When connecting the I^2C Bus/SMBus Monitor to a host computer and a target system, extreme care must be taken to avoid electrostatic discharge. Failure to follow ESD protection procedures when using the monitor unit could damage the host computer, monitor unit, or the target system, and void product warranty coverage.

3.1.1 Grounding Problems

When connecting the host computer, monitor unit, and target system, several potential grounding problems could exist. Some typical examples include:

Case 1 - Desktop and Single-board Computers. The chassis on a desktop or single-board host computer must be connected to earth ground to comply with safety regulations. If the computer chassis is NOT connected to earth ground for some reason (i.e., use of a two-prong power mains plug), the host computer power supply ground will float to some unknown voltage potential.

Case 2 - Laptop Computers. Laptop computers present special ESD problems. Most laptop computers use an external double-insulated mains power supply which is NOT connected to the mains earth ground. This means that the laptop chassis is floating at some unknown voltage potential.

Case 3 - Target Systems. The chassis on a target system may or may not be connected to earth ground. If the chassis is NOT connected to earth ground for

some reason (i.e., use of a two-prong power mains plug), the target system power supply ground will float to some unknown voltage potential.

In any case, upon connecting to the monitor unit, target system, and host computer, a discharge of energy may occur between the devices. This discharge could damage the host computer, monitor unit, and the target system.

3.1.2 Grounding Solutions

To avoid damage to the host computer, monitor unit, or target system, follow these instructions:

1. Wear an earth grounded wrist strap, or discharge any static charge build-up, when handling the monitor unit or any target system devices.
2. Ensure that both the host computer and target system are connected to a common earth ground point.
3. Make sure that all interconnections are made BEFORE applying power to the host computer, monitor unit, and target system.
4. If you are using a laptop computer or host computer that is NOT connected to mains earth ground, make a hard-wired connection from the host computer metal enclosure or ground point and the target system ground connector to a common earth ground point.
5. Avoid plugging and unplugging system components while the host computer or target system is powered.
6. Ensure that any devices connected to the target system are properly grounded to the common earth ground point.
7. If unsure how to properly ground system components, seek electrical expert help.

An alternative solution to grounding problems is to avoid connecting the monitor unit to both the host computer and target system at the same time. This can be achieved by collecting bus data with the monitor unit in stand-alone mode, then transferring buffered data to the host computer in dump mode.

WARNING: Any damage caused by Electrostatic Discharge (ESD) through inadequate earth grounding is NOT covered under the warranty of this product.

3.2 Connecting a Power Source

The I^2C Bus/SMBus Monitor can be powered from either internal or external power sources.

3.2.1 Internal Battery Power (ON)

An internal 9V battery provides unit power when the power switch is in the ON position. This power source allows the unit to operate stand-alone, or when another power source is unavailable.

3.2.2 External Power (EXT)

When the power switch is in the EXTernal position, the unit can be powered from:

1. The BUS +5V (V) line.
2. A regulated +5V wall power supply (#MWT-5VAG) through the external power jack (+5V) using a 2.5mm barrel plug, center tap positive.

~ ~ ~ ~ CAUTION ~ ~ ~ ~

Powering the monitor from its +5V external power jack applies power to the BUS +5V (V) line. The BUS (V) line should only be connected to the system under test if:

a) You are powering the monitor from the target system; or,
b) You are powering the target system from the monitor.

DO NOT CONNECT BOTH THE MONITOR AND TARGET POWER SUPPLIES TOGETHER.

3.3 Connecting to an I^2C Bus/SMBus

The I^2C Bus/SMBus Monitor includes two alternative methods for connection the monitor unit to an I^2C Bus or SMBus under test, a clip-lead cable, and an I^2C interface cable. Information on these cables are available in the I^2C Bus/SMBus Connector (BUS) section of this guide. The minimum test connections are Clock, Data, and Ground. For information on using the +5v option, see the “External Power” section of this guide.

3.4 Connecting the External Trigger

The I^2C Bus/SMBus Monitor provides External Triggering for Trace synchronization with external events. Trace synchronization allows bus traffic to be

collected immediately before or after an electronic event.

A High-to-Low transition on the External Trigger port can be used to start a PRE-TRIG trace, or stop a POST-TRIG trace. See the Trace Mode section of this guide for trace synchronization details.

4 Monitor Operations

The I^2C Bus/SMBus Monitor operates in one of two modes, stand-alone and remote. In *stand-alone mode*, the built-in display and keypad support the capture and display of bus data. No connection to a host computer is required. In *remote mode*, the monitor is controlled by a host computer via its serial communications port.

4.1 Stand-Alone Mode

4.1.1 Quick Start

1. Connect monitor to the target bus.
2. Turn monitor power to ON or EXT.
3. Select address mode ALL or SELECT.
4. Press the PRE-TRIG or POST-TRIG Trace button to begin data capture.
   a. PRE-TRIG waits for TRIG↓ line low or repeat PRE-TRIG button press, and collects data until the internal buffer is full or another button is pressed.
   b. POST-TRIG collects data until TRIG↓ line low or another button pressed. Oldest buffered data is overwritten.
5. Press VIEW-DATA button to end capture and enable BYTE, MSG, and BUFFER display scroll buttons.

4.1.2 Operating Modes

When using the I^2C Bus/SMBus Monitor in stand-alone mode, the unit performs data collection and display using five (5) operating modes. These operating modes include:

Operating Mode	**Description**
Address Selection	Select slave address to monitor
View Status	View bus signal logic levels

Trace	Capture bus message data
View Data	View captured bus data
Simulation	Simulate bus message data

4.1.2.1 Address Select Mode

Address Select Mode is used to select the bus slave address or addresses the unit will monitor. Address Select Mode is entered by pressing the MONITOR-SELECT or MONITOR-ALL key on the unit's front panel.

The MONITOR-SELECT key is used to specify a single bus slave address to monitor. The first time this key is pressed, the unit will display the current selected slave address. Subsequent key presses will step the unit through all possible slave addresses. Release the key to select a specific slave address.

Pressing the MONITOR-ALL key instructs the unit to collect bus traffic to all slave addresses.

Pressing any other mode select key terminates Address Select Mode with the displayed slave address selected. Slave address selection may also be set with the Select Address serial port command.

4.1.2.2 View Status Mode

View Status Mode displays I^2C Bus/SMBus signals and TRIG line levels. View Status Mode is entered by pressing the VIEW-STATUS key on the monitor unit's front panel.

In View Status Mode, the unit displays the following line levels ("0" for < 0.5V, "1" for > 3.0V):

V - Bus +5V Line
SCL - Clock
SDA - Data
TRIG - Trace Trigger Input

Selecting any other operating mode terminates View Status Mode.

4.1.2.3 Trace Mode

In Trace Mode, the unit collects and stores all or selected bus traffic with PRE or POST Trace triggering.

Trace Mode is entered by pressing the PRE-TRIG or POST-TRIG key on the unit's front panel. All previously collected data is erased from the monitor's internal storage. Bus traffic to one or all slave devices is collected in accordance with the current Address Select Mode defined above.

Pressing the PRE-TRIG key instructs the unit to start collecting bus traffic upon receiving a trigger signal. Pressing the PRE-TRIG key again, or a High-to Low transition on the External Trigger line will start data collection with the next START condition on the bus. Once started, PRE-TRIG data collection continues until the monitor's internal trace buffer is full, or another operating mode is selected.

Pressing the POST-TRIG key instructs the unit to start collecting bus traffic immediately with the next START condition on the bus. Once started, POST-TRIG data collection continues until a High-to-Low transition is detected on the External Trigger line, or another operating mode is selected. Once the trace buffer is full, POST-TRIG tracing continues collecting data by overwriting the oldest stored data with the newest.

Selecting any other operating mode terminates Trace Mode.

4.1.2.4 View Data Mode

View Data Mode displays data captured during the last trace of bus activity. View Data Mode is entered by pressing the VIEW-DATA key on the unit's front panel.

Displayed information includes:

- Number of Messages and Bytes Captured
- Start/Stop Events
- Message Number and Message Byte Number
- Message Destination Slave Address
- Read/Write Requests
- Acknowledgments and Negative-Acknowledgments
- Transmitted Data in Hex and ASCII

View Data Mode supports forward and reverse scrolling of captured data bytes or messages. View Data Mode key actions include:

Key	Action
BYTE-UP	- Move Backward one byte.
BYTE-DOWN	- Move Forward one byte.
MSG-UP	- Move Backward one message.
MSG-DOWN	- Move Forward one message.
BUFFER-UP	- Move to Start of buffer.
BUFFER-DOWN	- Move to End of buffer.

The monitor uses the following display syntax:

I^2C Event	Display
Start of Buffer	[- START OF TRACE -]
.	
Start Read w/Ack	[MMMM:START AA RA]
Data w/Ack	[MMMM:NNN DD ′C ′A]
Stop Condition	[MMMM:STOP]
.	
End of Buffer	[-- END OF TRACE --]

where:
- MMMM - Trace Message Number
- NNN - Message Byte Number
- AA - Device Address in Hexadecimal Format
- DD - Data in Hexadecimal Format
- C - Data in ASCII Format
- R/W - Read or Write Request
- N/A - Receiver Negative or Positive Acknowledgment

Selecting any other operating mode terminates View Data Mode.

4.1.2.5 Bus Simulation Mode

In Bus Simulation Mode, the monitor simulates I^2C Bus traffic without a bus connection. Emulation provides a learning and testing platform without the need for a working bus.

Bus simulation is enabled by pressing the BUFFER-UP key on the unit’s front

panel during the power-up sequence. Once enabled, bus simulation remains in effect until the next unit power-up cycle.

During Trace operations, bus simulation repetitively simulates the following three bus messages:

Start, Slave Address x02, Write, Acknowledge, “Hello”, Stop
Start, Slave Address x04, Write, Acknowledge, “World”, Stop
Start, Slave Address xFE, Read, Negative Acknowledge, Stop

Bus simulation is also be enabled when the monitor unit receives an Enable Bus Simulation command at its serial port.

4.2 Remote Mode

In *remote mode*, the monitor is controlled by a host computer via a USB or RS-232 interface cable. In this mode, bus traffic can be collected or uploaded to the Host system for storage and further analysis. Remote Mode is entered when the monitor unit receives a Remote command at its serial port (COM).

The monitor responds to a variety of serial port commands including:

- Baud Rate Select
- ASCII or Binary Remote Upload Select
- Slave Address Select
- Dump Trace Buffer
- Remote Trace
- Help

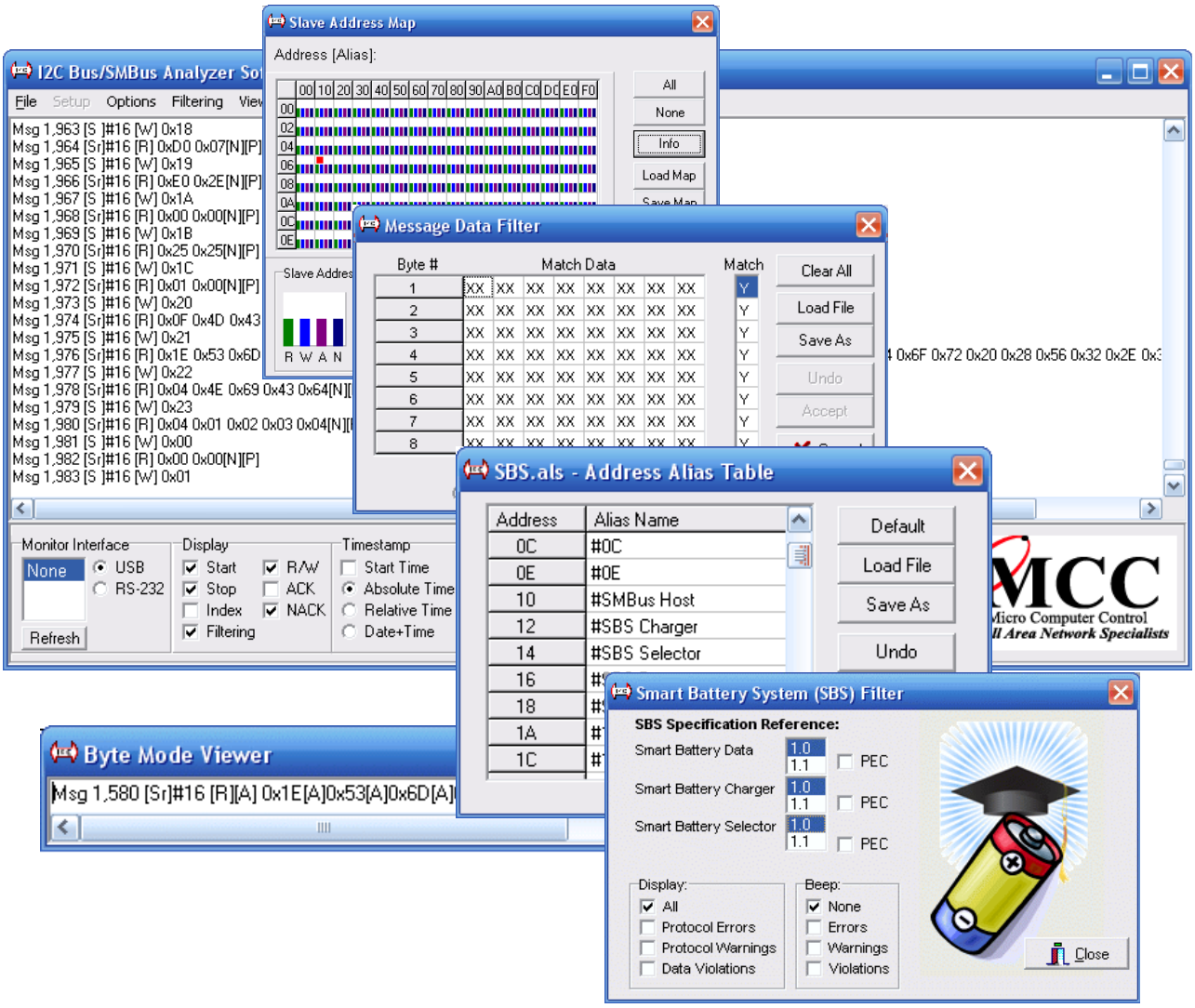
For remote operations, MCC offers Windows-based I^2C Bus/SMBus Analyzer software. This software is described in Part 2 of this guide. Remote mode operations can also be controlled by custom user developed software. For more information see the Programmer’s Reference section in this guide.

Selecting any other operating mode terminates Remote Operating Mode.

Part 2

I²C Bus/SMBus Analyzer Software

Release 3



The I²C Bus/SMBus Analyzer Software provides real-time capture and on-screen display of live or previously recorded I²C Bus or SMBus messages. It is designed to work with the I²C Bus/SMBus Monitor (#MIIC-101). The software also provides filtering of displayed messages by device slave address read/write/ack/nack events, message data match/no-match events, and Smart Battery System events, and provides a global display of bus activity over all 7-bit slave addresses.

1 Quick Start

1. Install the software (see CD/Download Installation below).
2. Connect monitor to the target bus.
3. Connect monitor to host PC USB or RS-232 ComPort.
4. When first using the USB interface cable, the USB driver should download and install automatically.
5. Turn monitor power to ON (battery) or EXT (external).
6. Select the USB/RS-232 ComPort connected to bus monitor.
7. Click Trace button.

2 Software Installation (CD)

1. Administrative Privilege May Be Required.
2. Insert CD.
3. If AutoRun does not start, double-click Setup.exe on CD.
4. Follow instructions on screen.

3 Software Installation (Download)

1. Administrative Privilege May Be Required.
2. Follow web page instructions to download and install software.

4 Equipment Setup

1. Connect the monitor to the host computer using the USB or RS-232 interface cable.
2. Connect monitor to the target I²C Bus/SMBus using the provided clip lead cable or I²C Interface Cable.
3. Connect the monitor power supply to an available AC power source and connect the power supply power jack to the monitor +5V connector (optional).
4. Turn monitor power ON (battery power) or EXT (external power).

NOTE: Previously collected Log files (*.i2cx or *.i2c) may be analyzed off-line without connection to the bus monitor. Several sample Log files are installed during product installation. See the “Setup|Open File for Read” section below.

5 Starting The Program

1. From Start Menu, select Programs|I2C Bus_SMBus Analyzer.
2. Click on I2C Bus_SMBus Analyzer.

6 Bus Data Display

The I^2C Bus/SMBus Analyzer Software can display real-time, buffered, or pre-recorded Log file data.

6.1 Real-time Data Display

Real-time data displays bus data as it is collected by the monitor unit. Click the “Setup|Trace Control|Remote Trace” menu item, select the USB or RS-232 ComPort connected to the I^2C Bus/SMBus Monitor, then click on the Trace Button.

If Log File recording is enabled, all message data received from the monitor is stored in the currently active Log file. If Display File recording is enabled, all displayed message data is stored in the currently active Display file.

6.2 Buffered Data Display

Buffered data displays bus data previously collected by the monitor unit while operating in the stand-alone mode. Click the “Setup|Trace Control|Dump Buffer” menu item, select the ComPort connected to the I^2C Bus/SMBus Monitor, then click on the Dump Button.

If Log File recording is enabled, all message data received from the monitor is stored in the currently active Log file. If Display File recording is enabled, all displayed message data is stored in the currently active Display file.

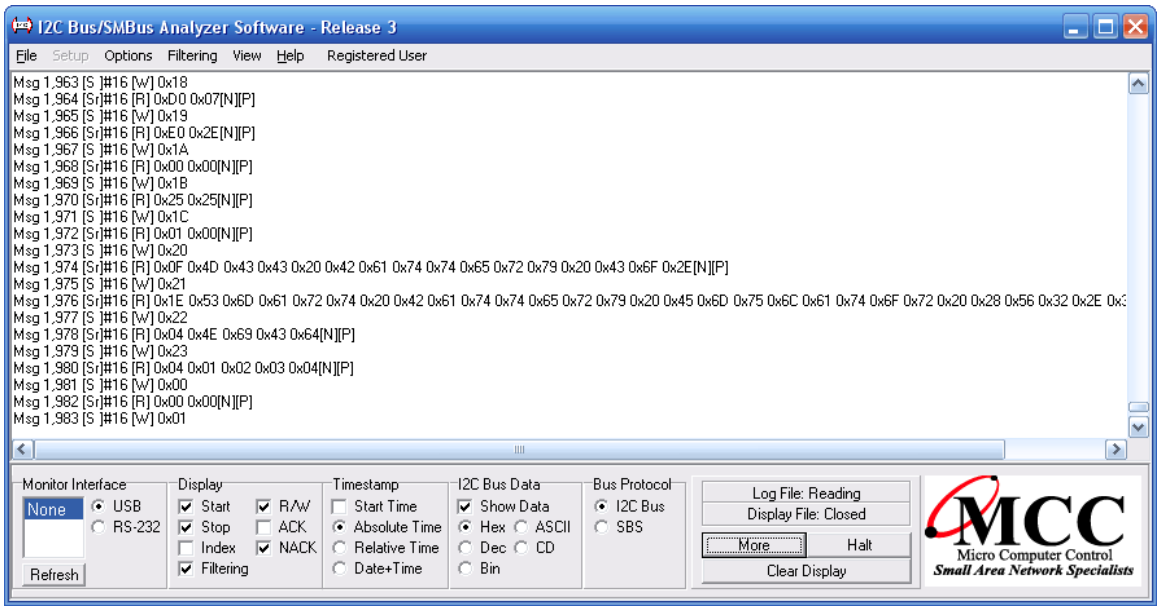
6.3 Log-file Data Display

Log-file data displays bus data previously recorded by the I²C Bus/SMBus Analyzer Software in a Log file. Click “Setup|Open File for Read”, and select an I²C log file (*.I2C or *.I2CX). Several sample log files are installed in the software default folder during software installation. Log files may also be exchanged with associates or co-workers for remote analysis.

7 Program Controls

I²C/SMBus Analyzer Software program controls consist of view windows, buttons, list boxes, check boxes, grid controls, menu items, and dialog boxes. This section describes these controls and explains how to use these controls to capture and display bus message data.

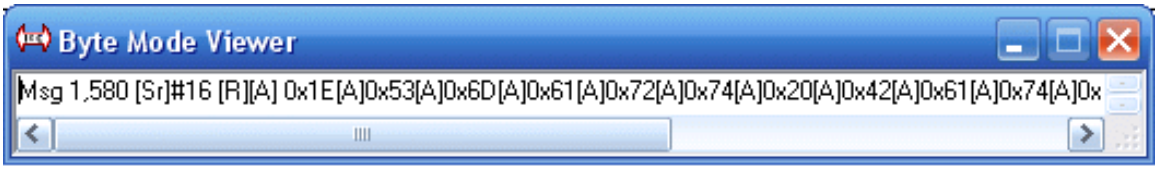
7.1 Message Mode Viewer



The Message Mode Viewer is the main screen for displaying bus messages. The Message Mode Viewer displays messages that are enabled in the Slave Address Map and Message Data Filter control. Message display format is controlled by the currently-selected Display, Timestamp, I²C Bus Data, and Bus Protocol controls.

Message Mode Viewer messages are displayed upon the detection of a bus REPEATED-START or STOP event.

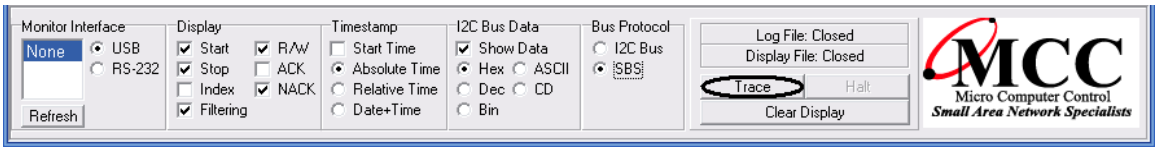
7.2 Byte Mode Viewer



The Byte Mode Viewer displays bus events for the current message as they are detected. Byte Mode Viewer messages are NOT filtered by the Slave Address Map or Message Data filter controls. Messages are displayed using the Hex format. Open the Byte Mode Viewer by clicking on the “View|Byte Mode Viewer” menu item.

Use the Byte Mode Viewer to display message events as they cross the bus. The Byte Mode Viewer is especially useful in displaying partial bus messages. That is, messages that never finish due to master or slave device problems.

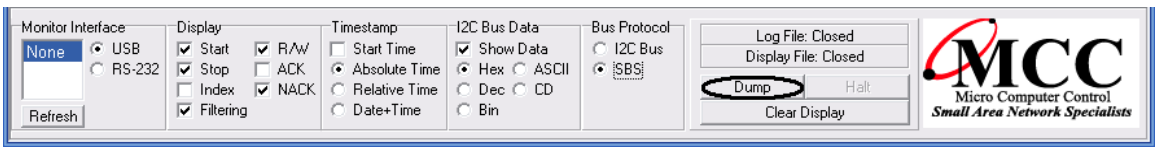
7.3 Trace Button



Click the Trace button to put the I²C Bus/SMBus Monitor in Remote Mode, and display real-time messages captured from the I²C or SMBus. Message data begins with the next bus START event. The Trace button is available when the “Setup|Trace Control|Remote Trace” menu item is selected.

If Log file recording is enabled, message data received from the monitor is stored in the currently active Log file. If Display File recording is enabled, all displayed message data is stored in the currently active Display file.

7.4 Dump Button

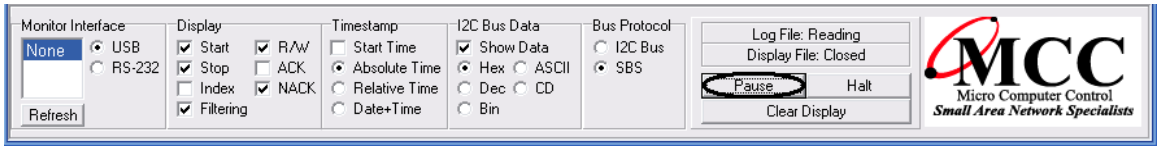


Click the Dump button to put the I²C Bus/SMBus Monitor into Dump Mode, and display any bus messages held in the monitor’s internal buffer. Dump Mode allows bus message data previously recorded in monitor stand-alone mode to be later transferred to a Host computer. Monitor data is maintained while external or internal (i.e., battery) power is enabled. The Dump button is available when the

“Setup|Trace Control|Dump Buffer” menu item is selected.

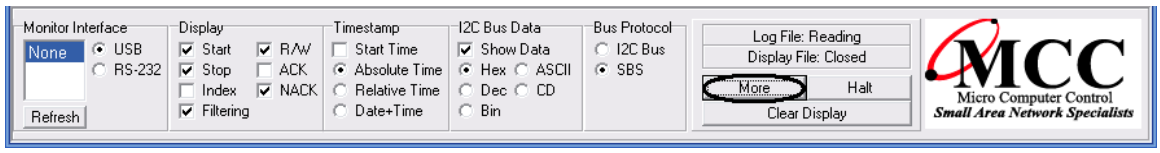
If Log file recording is enabled, message data is stored in the currently active Log file. If Display File recording is enabled, all displayed message data is stored in the currently active Display file.

7.5 Pause Button



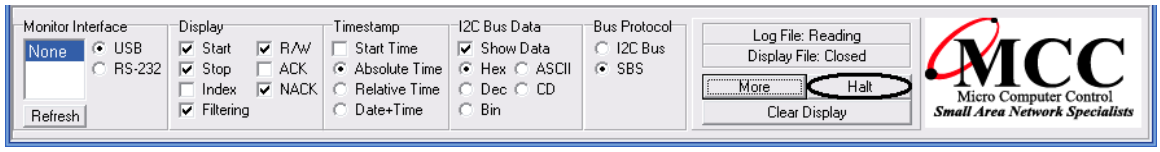
Click the Pause button to pause the display of log file messages. The Pause button is available when the “Setup|Open File for Read” menu item is selected, and Log file messages are being displayed.

7.6 More Button



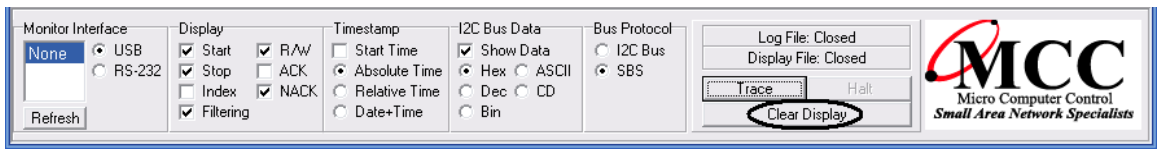
Click the More button to continue the display of paused Log file messages. The More button is available when the “Setup|Open File for Read” menu item is selected, and the message display has been paused or is full.

7.7 Halt Button



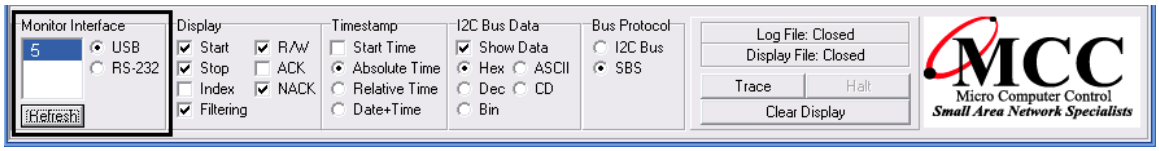
Click the Halt button to terminate monitor Remote Mode, Dump Mode, or the display of Log file messages.

7.8 Clear Button



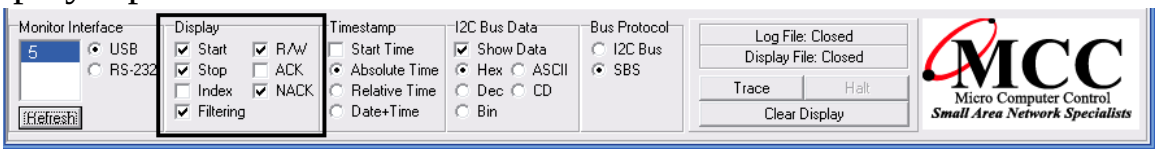
Click the Clear button to manually clear the message display area.

7.9 Monitor Interface Control



Use the Monitor Interface control to select the interface type and ComPort connected to the I²C Bus/SMBus Monitor. The Monitor Interface control provides a list of all selected interface type ports detected on the Host computer. Click the Refresh button to refresh the list.

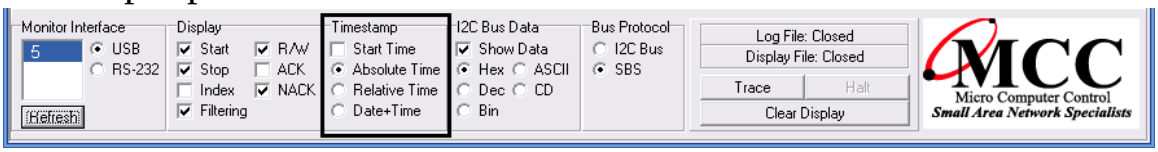
7.10 Display Options



Display check boxes control the display of events within I²C or SMBus messages, including:

- Start/Stop Events
- Byte Index within Message
- Read/Write Events
- Acknowledgment/Negative-Acknowledgment Events
- Filter (Slave Address, Message Data, and SBS) Enable/Disable

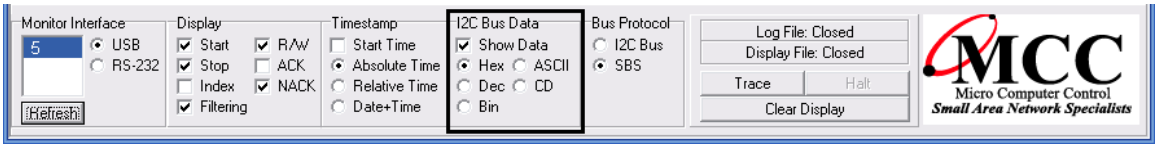
7.11 Timestamp Options



Timestamp check boxes control the display of message start event times for I²C or SMBus messages, including:

- Start Time Display Enable/Disable
- Absolute Time from the First Message
- Relative Time form the Last Message
- Data+Time of the Start Event

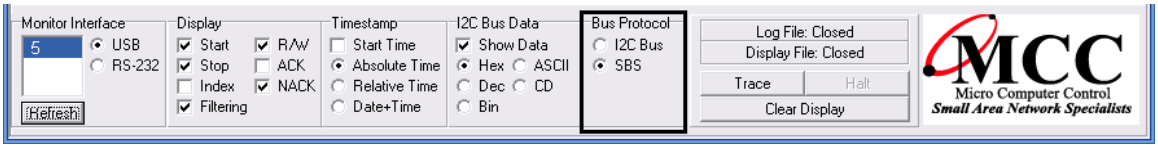
7.12 I²C Bus Data Display



The I²C Bus Data control selects how message data is displayed. Supported formats include:

Show Data	-	Enable/Disable I²C Bus Data Display
Hex	-	Hexadecimal [00...FF]
Dec	-	Decimal [0...255]
Bin	-	Binary [0000.1111]
ASCII	-	Printable ASCII or Hexadecimal [00...1F, space...~, 7F...FF]
CD	-	Comma-Delimited [00,11,22,...]

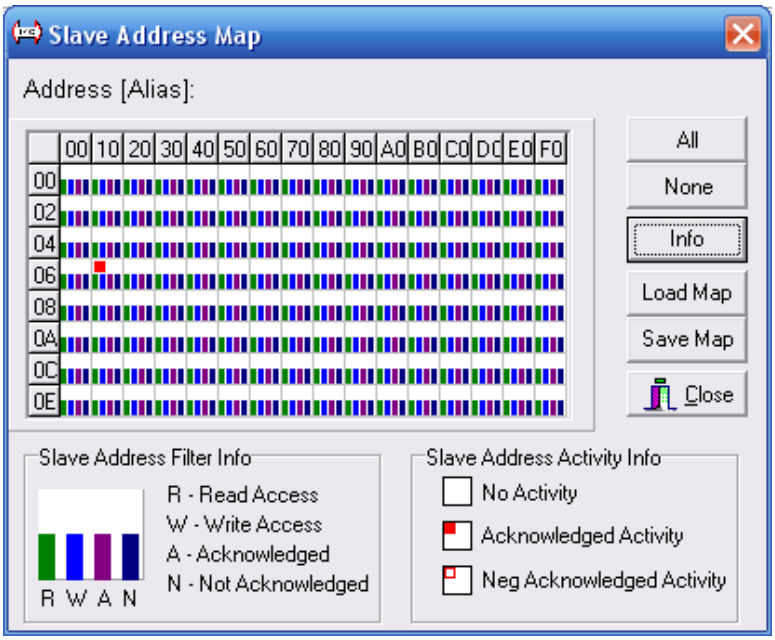
7.13 Bus Protocol



The Bus Protocol control selects the protocol used to parse and display message data. Supported protocols include:

I²C Bus	-	I²C Bus Data Display
SBS	-	Smart Battery System Data Display [mA, mV...]

7.14 Slave Address Map

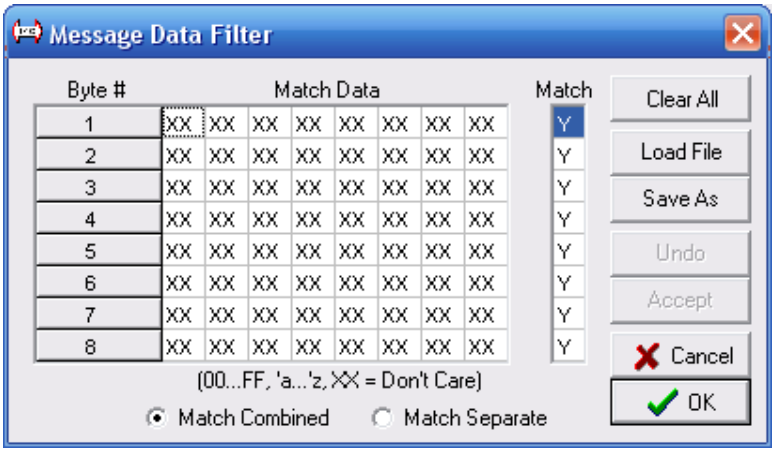


Use the Slave Address Map to view slave device activity on the bus and filter Message Viewer displayed messages.

The Slave Address Map indicates slave address activity on the bus with a solid red dot (■) for a slave address acknowledgment, and a hollow red dot (□) for a negative acknowledgment.

The Slave Address Map also controls message display filtering in the Message Viewer. Click on a slave address grid position to select display of slave address Read, Write, Acknowledged, or Not Acknowledged messages. Open the Slave Address Map by clicking on the “Filtering|Slave Address” menu item.

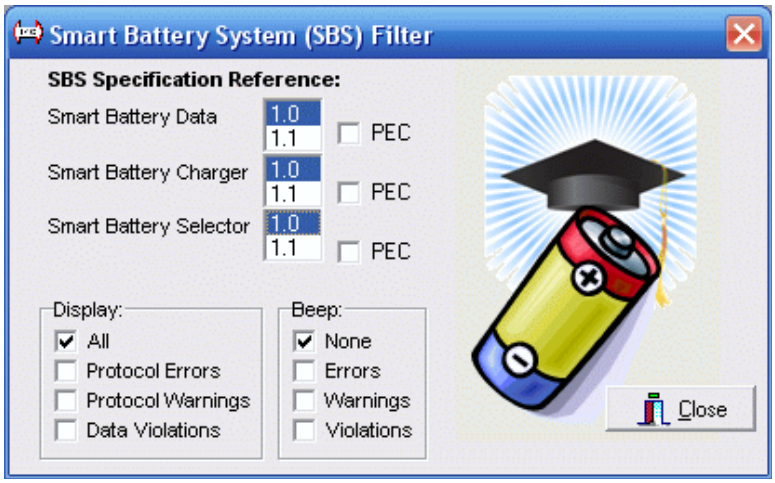
7.15 Message Data Filter



Use the Message Data Filter to filter the Message Viewer display of bus messages

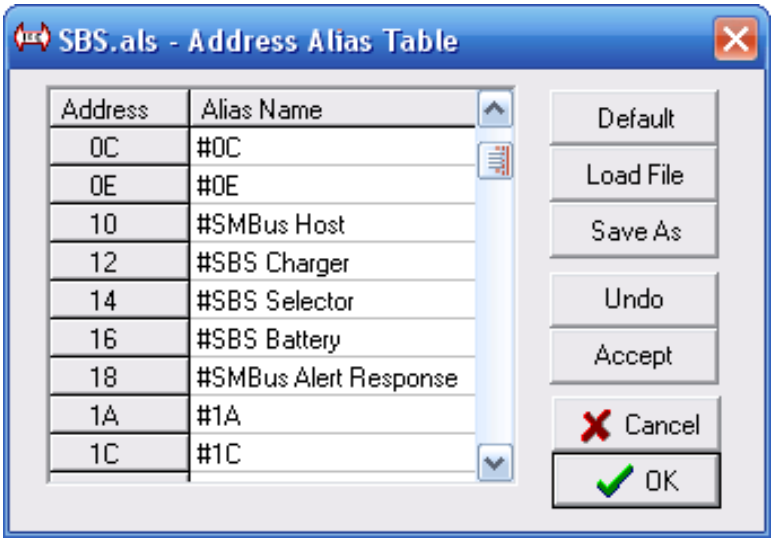
by message data content. Combined (Write+Read) or separate (Write or Read) message data within the first eight (8) bytes following a bus Start event can be tested for a match or no match condition. Open the Message Data Filter by clicking on the “Filtering|Message Data” menu item.

7.16 Smart Battery System (SBS) Filter



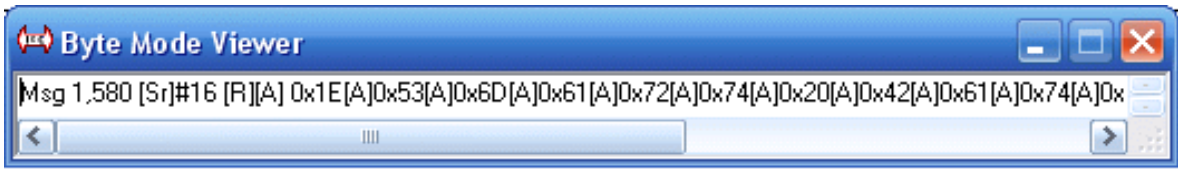
Use the Smart Battery System (SBS) Filter to control and filter the Message Viewer display of Smart Battery System messages. Open the Smart Battery System Filter by clicking on the “Filtering|Smart Battery System” menu item.

7.17 Address Alias Table



Use the Address Alias Table to customize the display of slave address names displayed by the Message Viewer. By default, device slave addresses are display in hexadecimal. The Address Alias Table allows the customization of displayed slave device names for your specific setup. Open the Address Alias Table by clicking on the “View|Address Alias Table” menu item.

7.18 Byte Mode Viewer



Use the Byte Mode Viewer to view bus events for the current message as they are detected. Byte Mode Viewer messages are NOT filtered, and can be used to view incomplete bus messages that do not have a terminating Stop or Repeated-Start event. Open the Byte Mode Viewer by clicking on the “View|Byte Mode Viewer” menu item.

8 Program Menu Items

The following items are accessed from the program menu bar.

8.1 File|Save Display As

Click to save the currents of the Message Viewer to a text file.

8.2 File|Printer Setup

Click to Configure printer settings.

8.3 File|Printer Display

Print the messages in the Message Viewer.

8.4 File|Exit

Click to terminate trace and display activities, and exit the program.

8.5 Setup|Interface Settings|19.2K Baud

Click to set the I^2C Bus/SMBus Monitor serial port communications rate to 19,200 baud.

8.6 Setup|Interface Settings|57.6K Baud

Click to set the I^2C Bus/SMBus Monitor serial port communications rate to 57,600 baud. This baud rate may can cause loss of data on some older PCs.

8.7 Setup|Trace Control|Remote Trace

Click to enable real-time data collection in Remote Mode. In Remote Mode, clicking the Trace button will establish a USB or RS-232 link with the I^2C Bus/SMBus Monitor using the currently selected ComPort and Baud Rate, and place the monitor in Remote Mode. Data captured from the I^2C or SMBus will be transferred to the Host computer and displayed using the current display settings.

If Log file recording is enabled, message data is stored in the currently active Log file. If Display File recording is enabled, all displayed message data is stored in the currently active Display file.

8.8 Setup|Trace Control|Dump Buffer

Click to enable monitor-buffered data collection in Dump Mode. In Dump Mode, clicking the Dump button will establish a USB or RS-232 link with the I^2C Bus/SMBus Monitor, and place the monitor in Dump Mode. Bus message data previously stored in the monitor's internal buffer will be transferred to the Host computer and displayed using the current display settings.

If Log file recording is enabled, message data is stored in the currently active Log file. If Display File recording is enabled, all displayed message data is stored in the currently active Display file.

8.9 Setup|Open Log File for Write

Click to enable Log File recording. Subsequent message data received from the I^2C Bus/SMBus Monitor in Remote or Dump Modes is saved to the specified file (Time Stamped *.I2CX or Standard *.I2C). Saved Log files can be displayed using the "Setup|Open File for Read" menu item.

8.10 Setup|Open File for Read

Click to read a previously recorded file for processing and display. The program can read/process/display log files (Time Stamped *.I2CX or Standard *.I2C), or

ASCII text (*.TXT) files. Log file message data is displayed according to the current filtering and display options selected. ASCII text files are simply displayed.

8.11 Setup|Open Display File for Write

Click to enable Display File recording. Subsequent displayed messages are saved to the specified file (*.TXT). Saved Display files can be used to create bus activity documentation. If the Comma-Delimited (CD) Data Protocol is selected, Display files can be imported into spreadsheet programs for additional analysis.

8.12 Setup|Program Settings

Click to save, load, or restore default, program settings. The program settings are saved to the file I2C.INI. These settings automatically override default settings each time the program is started.

8.13 Options|Show Hints

Click to enable or disable the display of program control hints (i.e., tool tips).

8.14 Options|Word Wrap

Click to enable or disable the single line or wrap display of Message Viewer messages.

8.15 Options|SetFont

Click to select Message and Byte Mode Viewer display font characteristics.

8.16 Filtering|Slave Address

Click to display the Slave Address Map grid. Use the Slave Address Map to monitor slave device activity and filter displayed messages. See the Slave Address Map control section of this guide for details.

8.17 Filtering|Message Data

Click to display the Message Data Filter. Use the Message Data Filter to filter displayed messages by data content. See the Message Data Filter control section of this guide for details.

8.18 Filtering|Smart Battery System

Click to display the Smart Battery System Filter. Use the Smart Battery System Filter to control the display of Smart Battery System messages. See the Smart Battery System Filter section of this guide for details.

8.19 View|Address Alias Table

Click to display the Address Alias Table. The Address Alias Table allows user customization of displayed slave device names.

8.20 View|Byte Mode Viewer

Click to display the Byte Mode Viewer. The Byte Mode Viewer displays bus events for the current message as they are detected. Byte Mode Viewer messages are NOT filtered by the Slave Address Map control. Messages are displayed using the ASCII or Hex Protocol, with message display format controlled by the currently-selected Display Options.

8.21 Help|ReadMe

Click to display program technical notes.

8.22 Help|Release Report

Click to display the program release information.

8.23 Help|Check for Updates

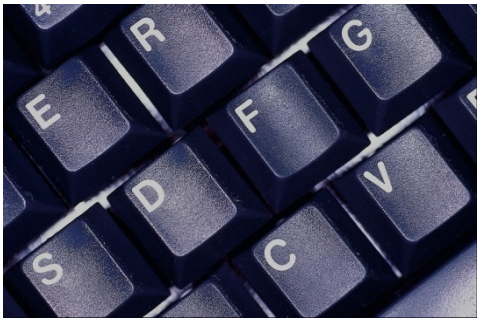
Click to display the program update information. Internet connection required.

8.24 Help|About

Click to display program information.

Part 3

Programmer’s Reference



This section is a description for programmers writing custom applications.

The Host System Interface provides serial port access to monitor data capture functions. The monitor provides the following serial port commands to assist in bus traffic collection:

19.2K Baud Select 1
57.6K Baud Select 5
ASCII Remote Select . . . . . A
Binary Remote Select . . . . . B
CTS/RTS Handshaking C
Dump Trace Buffer . . . . . D
Enable Bus Simulation . . . . . E
Remote Trace . . . . . R
Select Address . . . . . S(ALL| [Slave Address])
Test System . . . . . T
Escape . . . . . <Esc>
Screen Pause . . . . . <Ctrl - S>
Screen Resume . . . . . <Ctrl - Q>
?Help . . . . . ?

The following sections give details on the syntax and operation of these commands.

Command Syntax

Serial commands consist of a single ASCII character command key possibly followed by command parameters and terminated with a <Carriage Return>.

( ) Optional parameters.

[ ] Numeric parameters. All such parameters are specified in hexadecimal without a radix specifier. Example 00 to FF.

| Alternate selection. Only one of the alternate selections is permitted.

< > Control keys.

1 Serial Port Commands

Command	Syntax	Description
Baud Rate Select	1<CR> 5<CR>	19.2K baud select 57.6K baud select
ASCII Protocol Select	A<CR>	Configure Remote Trace to send trace data in ASCII format.
Binary Protocol Select	B<CR>	Configure Remote Trace to send trace data in binary format.
CTS/RTS Flow Control	C<CR>	Toggle Clear To Send (CTS) / Request To Send (RTS) serial port flow control.
Dump Trace Buffer	D<CR>	Dump pre-recorded message trace data in ASCII format.
Enable Simulation	E<CR>	Simulate bus message traffic without a bus connection.
Remote Trace	R<CR>	Place monitor in Remote Mode and sends all captured bus traffic to the serial port in the current selected format (ASCII or Binary).
Slave Address Select	SALL<CR> Sxx<CR>	Monitor all Monitor single slave address
System Test	T<CR>	Enter test mode
?Help	?<CR>	Display monitor help

1.1 Baud Rate Select

Syntax: 1 (9200) | 5(7600)

Description:

The Baud Rate Select command sets the monitor unit's serial port to 19.2K or 57.6K baud. The unit defaults to 19.2K baud at power-up.

NOTE: Executing a Remote Trace on high volumes of bus traffic at 19.2K baud may cause loss of data due to monitor unit internal buffer overflows. Buffer overflows are marked in the trace data stream with the "???" string.

NOTE: When executing a Remote Trace at 57.6K baud, the Host computer may miss incoming data on character overwrites. Character overwrite detection is a function of your Host computer software.

NOTE: Immediately after issuing a Baud Rate Select command, the Host computer serial port must also change to the matching baud rate.

Example: 5 <CR> - 57.6K baud selected.
1 <CR> - 19.2K baud selected.

1.2 ASCII Remote Select

Syntax: A

Description:

The ASCII Remote Select command configures Remote Trace data to be sent to the serial port in printable ASCII format. At power-up, ASCII Remote is the default transfer mode.

When ASCII Remote in enabled, data is transferred in three-character ASCII sets. The first character specifies the bus event type. The following two characters represent an 8-bit slave address or data byte value.

When executing a Remote Trace, data is sent to the serial port in the following ASCII format:

TAATXX ...TXX<CR><LF>

where:

T - Event Type
- 1 - Start with Acknowledgment.
- 2 - Start without Acknowledgment.
- 3 - Data with Acknowledgment.
- 4 - Data without Acknowledgment.
- 5 - Stop

AA - 8-bit Slave Address (x00...xFF).
XX - 8-bit Data (x00...xFF).

Example**:** A<CR>
R<CR>
150320...323500<CR><LF>

where:

150 - Start, Slave Address 0x50 with Acknowledgment.
320 - Data 0x20 with Acknowledgment.
.
323 - Data 0x23 with Acknowledgment.
500 - Stop.

In the above example, a single bus message is uploaded to the Host system in ASCII format during a Remote Trace.

1.3 Binary Remote Select

Syntax: B

Description:

The Binary Remote Select command configures Remote Trace data to be sent to the serial port in Binary format.

When Binary Remote is enabled, data is transferred in two-byte binary sets. The first byte specifies the data type, and is followed by a slave address or data byte.

When executing a Remote Trace, data is sent to the serial port in the following Binary format:

TATH...TH<CR><LF>

where:

T - Event Type
  1 - Start with Acknowledgment
  2 - Start without Acknowledgment.
  3 - Data with Acknowledgment.
  4 - Data without Acknowledgment.
  5 - Stop.

A - 8-bit Slave Address (x00...xFF).
H - 8-bit Data (x00...xFF).

NOTE: The Binary format is reserved for future MCC product support.

Example: B<CR>
R<CR>
150320...323500<CR><LF>

where:

150 - Start, Slave Address 0x50 with Acknowledgment.
320 - Data 0x20 with Acknowledgment.
.
323 - Data 0x23 with Acknowledgment.
500 - Stop.

In the above example, a single bus message is uploaded to the Host system in binary format during a Remote Trace.

1.4 CTS/RTS Handshaking Command

Syntax: C

Description:

The CTS/RTS Command is used to toggle Clear-to-Send / Request-to-Send serial port flow control. The power-up default condition is CTS/RTS Handshaking disabled.

When enabled, CTS/RTS Handshaking halts monitor serial port output when the Host RTS line is dis-asserted. This feature is useful in preventing serial link data overflow on the host system.

The monitor always supports X-ON/X-OFF Serial link flow control. Sending an X-OFF (Ctrl/S) character to the unit halts serial port output. Sending a subsequent X-ON (Ctrl/Q) character causes output to continue. This feature is useful during a Dump or Remote Trace to temporarily stop data scrolling.

Example: C<CR> - CTS/RTS Handshaking Enabled

1.5 Dump Trace Buffer

Syntax: D

Description:

The Dump Trace Buffer command sends all bus data collected during the last PRE-TRIG or POST-TRIG Trace to the serial port. Buffered data is unaltered by this operation.

Data is sent to the serial port in ASCII format. See the ASCII Remote Select command for format details.

Dump Trace Buffer terminates upon exhausting the buffer, or upon receiving an Escape <ESC> character on the serial port.

Screen Pause <Ctrl-S> and Screen Resume <Ctrl-Q> are active.

Example: D<CR>

In the above example, buffered bus messages are uploaded to the Host system in ASCII format during a Dump Trace Buffer operation. See the ASCII Remote Select command for format details.

1.6 Enable Bus Simulation

Syntax: E

Description:

The Enable Bus Simulation command causes the unit to emulate bus traffic without a bus connection. Emulation provides a learning and testing platform without the need for a working bus.

Bus simulation repetitively generates the following three messages:

10234836536C36C36F500 - Start, Slave Address x02 w/Ack, “Hello”, Stop
10435736F37236C364500 - Start, Slave Address x04 w/Ack, “World”, Stop
2FF500 - Start, Slave Address xFF w/Nack, Stop

See ASCII Remote Select for details on ASCII format.

Once enabled, bus simulation remains in effect until the next monitor unit power-up cycle.

Bus simulation can also be enabled by pressing the BUFFER-UP key during the unit power-up sequence.

Example: E<CR> - Enable Simulation

1.7 Remote Trace

Syntax: R

Description:

The Remote Trace command places the unit in Remote Mode. Starting with the next bus START event, all bus events are sent to the serial port.

During a Remote Trace, data is temporarily buffered in the monitor unit, then sent to the serial port in the currently-selected ASCII or Binary format. See the ASCII Remote Select or Binary Remote Select commands for data format details.

Remote Trace terminates upon receiving a High-to-Low transition on the External

Trigger line or receiving an Escape <ESC> character on the serial port.

Screen Pause <Ctrl-S> and Screen Resume <Ctrl-Q> are active.

Example: R<CR> - Start Remote Trace

In the above example, bus messages are buffered and uploaded to the Host system in the selected ASCII or Binary format. See the ASCII Remote Select or Binary Remote Select commands for data format details.

1.8 Select Address

Syntax: S(ALL | [Slave Address])

Description:

The Select Address command is used to select the bus slave address or addresses the unit will monitor. During a PRE-TRIG, POST-TRIG, or Remote Trace, the unit will capture all messages sent to this address.

Entering parameter ALL instructs the unit to collect bus traffic to all slave addresses.

Entering a slave address parameter specifies a single bus address to monitor.

Slave address selection may also be set with the MONITOR-SELECT or MONITOR-ALL keys. For more information see the “Address Select Mode” section in this guide.

Example: SALL<CR> - Monitor ALL Slave addresses.
S50<CR> - Monitor slave address x50.

1.9 Test System

Syntax: T

Description:

The Test System command invokes manufacturing test functions. This command is reserved for MCC use only.

NOTE: The Test System command is reserved for MCC manufacturing and support use only.

1.10 Help

Syntax: ?

Description:

The Help command displays the syntax for the Monitor command set.

Example: ?<CR> - display monitor Help Screen

Appendix A - Solving Problems

This section will help you solve problems in using the monitor.

Problem:

The monitor unit does not display the sign-on message on the internal LCD display at power-up.

Solution:

1. Check the monitor unit power supply. If the power switch is in the ON position, the unit is powered by the internal 9V battery. Check and replace a faulty battery.
2. If the switch is in the EXTernal position, the unit can be powered by a regulated +5V external power supply via the +5V power jack or the I^2C interface cable V lead. Check and replace any faulty power source.

Problem:

The monitor unit does not communicate on the serial link.

Solution:

1. Power-off, then power-on the monitor unit.
2. Check the serial link connection at the monitor unit and Host system.
3. Confirm that the monitor unit and Host system are communicating at the same baud rate and with the proper communication parameters.

Problem:

The monitor unit does not collect bus traffic in Trace Mode.

Solution:

1. Check cable connections at the monitor unit and target system bus. When using the clip-lead cable, confirm SCL, SDA, and GND clip leads are connected to appropriate bus lines.
2. If operating in stand-alone mode, check the monitor unit's selected slave address. If a single bus address is specified, only messages directed to that address will be collected. If operating in remote-mode, check the software enabled slave

addresses. Confirm the presence of bus traffic by monitoring all bus addresses.

3. When using the PRE-TRIG key in stand-alone mode, the monitor unit will wait for a trigger event (TRIG↓). Check the TRIG input using Line Status Mode. A High-to Low transition, with minimum 2 microsecond Low duration, is required to generate a trigger condition.

Problem:

Remote trace data displays ???, or Invalid Event Type.

Solution:

The monitor unit has experienced an internal buffer overflow. The monitor will continue to collect bus data, but some message data may be lost.

1. Increase the serial port baud rate to 57600.
2. Reduce collected bus messages with the MONITOR-SELECT key.
3. Reduce message traffic while performing bus data protocol tests.

Appendix B - Operating Specifications

Parameter	Min	Typ	Max	Unit
Temperature Range				
Operating Temperature	0		+50	˚C
Storage Temperature	-20		+70	˚C
D.C. Characteristics				
External Power	-5%	5	+5%	V
Input Current		20	40	mA
Internal Battery		9		V
SDA and SCL (I^2C Signals)				
Input Low Voltage	-.05		+1.5	V
Input High Voltage	+3.3		+5.5	V
Input Leakage Current			+-20	uA
Input Capacitance				
w/o Test Cable		20		pF
with Test Cable		60		pF
Trigger Input				
Input Low Voltage	-0.5		+0.9	V
Input High Voltage	+1.9		+5.5	V
Input Current			100	uA
Input Capacitance	20		60	pF

Appendix C - USB/RS-232 Serial Port Interface (Optional)

The USB/RS-232 Serial Cable provides the connection between the monitor and an optional Host computer. On the monitor, the Serial Cable connects to the modular RJ-45 connector marker COM. On the Host computer, the cable connects to a USB port or standard RS-232 serial communications port. Both RS-232 DB-25 and DB-9 Host computer connectors are supported.

When using a Host computer, data terminal, or terminal emulator program to access the monitor via its USB/RS-232 port, communication parameters must be properly set before communicating can begin.

The monitor operates with the following Serial Link communication parameters:

Baud Rate	* 19.2K or 57.6K
Parity	None
Data Bits	8
Stop Bits	1 or 2

* The monitor defaults to 19.2K baud at power up. See the Programmer's Reference section of this guide for more information on switching baud rates.

When using the RS-232 interface, the monitor's serial port is configured as a Data Communications Equipment (DCE) device, thus permitting direct connection to a PC's standard RS-232 serial communications port. In this configuration, only three (3) wires (TX, RX, and GND) are required to establish serial communication. An optional fourth handshaking wire may be used to establish hardware flow control.

DB-25 Pin Assignments		
Pin	Name	Description
2	TX	Transmit Data to Monitor
3	RX	Receive Data from Monitor
4	RTS	Request to Send to Monitor (Optional)
7	GND	Signal Ground

DB-9 Pin Assignments		
Pin	Name	Description
2	RX	Receive Data from Monitor
3	TX	Transmit Data to Monitor
5	GND	Signal Ground
7	RTS	Request to Send to Monitor (Optional)

Declaration of Conformity

This Declaration of Conformity is issued by the indicated company which is solely responsible for the declared compliance.

Product: I2C/SMBus Monitor
Product Part Number: MIIC-101
Product Description: I2C/SMBus Monitor

Applicable Directive(s): EC Directive 89/336/EEC

Compliant Standards:
EN 55022 : 1998
Emissions Standard
Conducted Emissions (Class B)
Radiated Emissions (Class B)

EN 55024 : 1998
Immunity Standard
Immunity to Radiated Electromagnetic Fields
Immunity to Fast Transient Bursts - AC Power Lines
Immunity to Conducted Field - AC Power Lines
Immunity to Voltage Dips - AC Power Lines
Immunity to Electrostatic Discharge

Test Laboratory Information:
Cass Industries Ltd., Blackbrook Trading Estate, Weybrook Road, Manchester M19 2QD, ENGLAND.
Test Report Number: CI02486b
Test Report Date: April 29th, 2005
Technical file held by: Micro Computer Control Corporation, 83 Princeton Avenue / PO Box 275, Hopewell, New Jersey 08525 USA, or its applicable authorized distributor or representative.

Responsible Company: Micro Computer Control Corporation, 83 Princeton Avenue / PO Box 275, Hopewell, New Jersey 08525 USA, or its applicable authorized distributor or representative.

Signature of Authorized Representative:

Edward Thompson

Name: Edward Thompson
Title: President, Micro Computer Control Corporation
Date: 13-MAR-12